

# In line with Industry 4.0

## Linear rotary direct motors in filling and closure applications

Filling and closure processes can be implemented dynamically and flexibly with linear rotary direct motors. That's why noted packaging machine manufacturer OPTIMA uses them in the closure units for its monoblock and free-standing machines. Another important reason is that the motors directly provide data on the actual stroke and torque values generated for ongoing quality assurance or subsequent process analysis. This type of drive supports modern Industry 4.0 concepts right down the line.



«Our customers in the food products, cosmetics, and chemical industries have to deal with smaller lot sizes and therefore more frequent product changeovers. We are currently working on a project, for example, where a filling and packaging line needs to be changed over to a new

product every 30 minutes,» says Andreas Seitz, Project Engineering Director for Food and Chemical Solutions at OPTIMA consumer GmbH. «It wasn't that long ago that one lot would run for one or two weeks. Now a half an hour is not uncommon.» Medium-sized companies in parti-

cular are driving this trend in the industries mentioned above. They include a German manufacturer that produces an extensive portfolio for discounters and drugstores, ranging from spot removers to wood and leather polishes to car care products for automotive interiors.

## Frequent product changeovers—short setup times

«These are not batches of a million units, like we typically see for laundry detergents,» explains Andreas Seitz. «On the contrary. Lots consist of a few thousand units, and the product range is enormous, with a nearly incomprehensible variety of package styles, shapes, and sizes. Order-based production is actually indispensable here for logistical reasons.»

The affected companies have correspondingly high demands for flexibility, setup times, and process reliability of the filling and packaging lines. OPTIMA



*OPTIMA relies on direct linear rotary drives in the closure units of its modern, rotary indexing closure machines, achieving output of up to 600 containers per minute. (Photo: Optima)*

started addressing this trend early and has adapted its packaging systems to the changing market conditions. Comprehensive modularization and the intensive use of servo technology form the foundation.

In 2016, the company converted the closure units in its packaging systems to direct-drive technology for medium and high-performance applications. Up to 16 closure spindles mounted vertically on a rotating table are driven by a linear rotary motor from LinMot's PR01 product family.

## Linear rotary motors provide flexibility in the manufacturing process



*LinMot's PR01 linear rotary motors are deliberately compact and combine a rotary and a linear direct motor in one housing, which can be controlled independently of each other.*

The highly dynamic electric motors, specially designed for closure and screwdriving processes, combine a linear and a rotary direct drive in a compact housing with IP 64 protection, each of which is actuated separately.

«This solution guarantees not only

highly dynamic screwdriving processes and currently up to 600 closure operations a minute for our users, but also allows them to adjust critical parameters, such as stroke length, impact force, angle of rotation, and torque from the user interface on the packa-

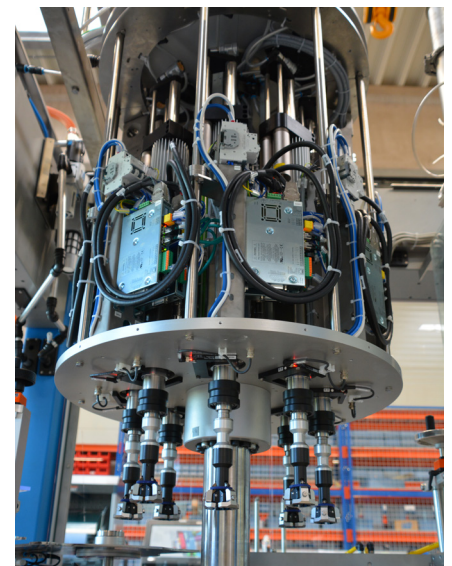
ging machine,» says Andreas Seitz of the significant advantages of this new closure technology. Time-consuming changeover of cam discs or manual setup of slip clutches are eliminated, so setup times are much shorter than for conventional systems.»

## Efficient and sustainable direct drives

Maintenance is also easier, as the linear rotary motion is implemented with direct linear and rotary drives, which do not produce dirt or dust and are not sensitive to them. If a defect occurs, the affected spindle can also be shut down until the repair can be made, so production can continue at a reduced pace. For a planned machine stop, it is also possible to finish production of the containers located in the closure system. These features, along with the fact that the selected parameters

can be achieved from a standing start when production resumes, even after a long period of downtime, contribute to the high efficiency of this solution.

*Quite efficient: With linear rotary direct motors from LinMot, the closure process for each spindle on the rotary dial can be designed individually and adapted to the product at the push of a button. This means that different types of closures, including screw-on and press-on caps, can be processed on the same machine. (Photo: Rossmann)*



## Compact form factor and extensive connectivity

«The use of linear rotary motors for closures is a logical step as lot sizes drop,» says engineer Markus Dierolf, a designer at OPTIMA who contributed significantly to the design of the new closure stack. «We decided to go with the LinMot solution because we have used them since 2011 for handling applications, for example, and have always had a good experience with them. For the closure system, it was particularly important that the motors be very compact and that the servo drives have numerous integral interfaces for various control systems.»

Even if it becomes necessary to change the format, however, the servo technology used, the lack of cam discs, and the resulting mechanical decoupling has a positive benefit. All spindles can be run up to the top position at the same time for better access when changing over the transport nests and closure heads to adapt to different geometry. They are safely held in this position by a «magnetic spring,» even when the machi-

ne is deenergized. This technology, developed by LinMot and sold under the name MagSpring, provides a constant force over the entire working range, unlike a mechanical spring, so it is optimal for balancing the force of gravity. Because the working principle is based on the attraction of permanent magnets, it also does not require an energy source, so the MagSpring can be used for safety functions without a problem.



*Magnetic springs (to the right of the black heat sink in the image) compensate for the weight of the closure spindle and maintain a safe position even when power has been disconnected.*

## Linear rotary motors as a data source

Another point in favor of direct linear rotary motors, which optimally supports digital transformation and traceability along with quality assurance measures, is that the motors «automatically» supply the parameters and the torque applied and distance traveled for every threading operation. «Our machines have been capturing and utilizing this data for a while, but now we can entirely eliminate the external sensors such as torque transducers and camera sys-

tems for height control,» explains Markus Dierolf. This reduces cabling and material costs and simplifies the transfer of data to upper-level systems.

The new OPTIMA closure units are very well received by their customers. «The customer who received the first packaging line equipped with LinMot technology has already ordered a second one to replace existing systems. I think that speaks for itself.»



*Dipl.-Ing. (BA) Markus Dierolf, designer at OPTIMA consumer GmbH. (Photo: Rossmann)*



## In the pipeline: linear rotary motors in filling stations



Andreas Seitz, Project Engineering Director for Food and Chemical Solutions at OPTIMA consumer GmbH.  
(Photo: Rossmann)

But OPTIMA is not yet satisfied. For the next step, the company plans to equip filling stations with linear rotary motors as well, as Andreas Seitz reports: «These concepts already exist. The arguments are the same as for the closure units—but here we are dealing with individual, parameter-based control of the filling needle motion at each filling point. This means optimal filling, even for extremely sensitive products that can easily decompose or that tend to foam easily.» The company has already demonstrated this with extensive filling tests using the new technology. Over the longer term, the packa-

ging machine specialist wants to expand the new filling and closure technology to other industries and applications. LinMot still has some homework to do for this, which Seitz has sent back with the responsible parties: «Along with the existing ATEX linear motors from LinMot, we want solutions that allow linear rotary motors and servo drives to be used in an ATEX environment as well. It would also be very helpful if the motors and control electronics were located in a single housing.» LinMot has followed this wish and already presented the first solutions at the SPS/IPC/DRIVES 2017 show.



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